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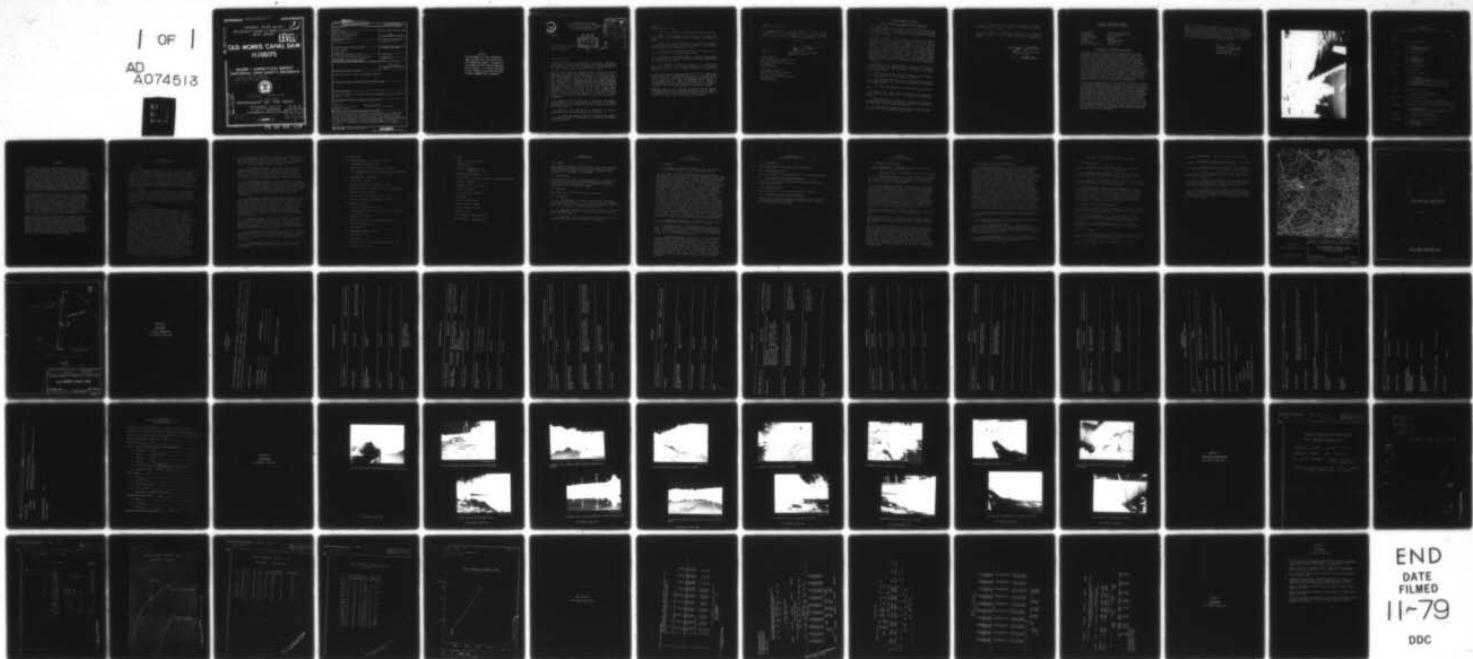
NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION TRENTON  
NATIONAL DAM SAFETY PROGRAM. OLD MORRIS CANAL DAM (NJ-00173). P--ETC(U)  
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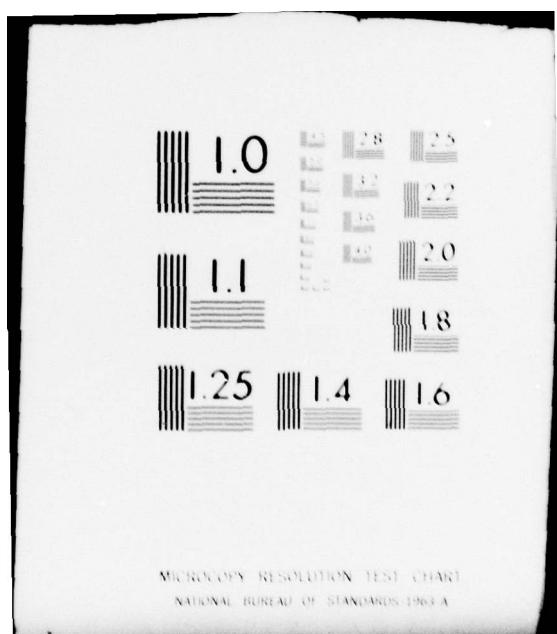
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PASSAIC RIVER BASIN  
ROCKAWAY RIVER, MORRIS COUNTY  
NEW JERSEY

# LEVEL

# OLD MORRIS CANAL DAM

NJ00173

# PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM.

Old Morris Canal Dam (NJ-00173).  
Passaic River Basin. Rockaway River,  
Morris County, New Jersey.



Final rept., 10 Warren A. Guinan

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**DEPARTMENT OF THE ARMY**

Philadelphia District  
Corps of Engineers  
Philadelphia, Pennsylvania

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER  NJ00173	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  Phase I Inspection Report National Dam Safety Program Old Morris Canal Dam Morris County, N.J.	5. TYPE OF REPORT & PERIOD COVERED  FINAL	
7. AUTHOR(s)  Guinan, Warren A., P.E.	6. PERFORMING ORG. REPORT NUMBER  DACPW61-79-C-0011✓	
9. PERFORMING ORGANIZATION NAME AND ADDRESS  Anderson-Nichols 6 Louden Rd. Concord, NH 03301	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS	
11. CONTROLLING OFFICE NAME AND ADDRESS  U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106	12. REPORT DATE  July, 1979	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	13. NUMBER OF PAGES  45	
	15. SECURITY CLASS. (of this report)  Unclassified	
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE	
16. DISTRIBUTION STATEMENT (of this Report)  Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES  Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)  Dams Spillways Old Morris Canal Dam, N.J. Visual Inspection	Structural analysis National Dam Inspection Act Report	
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.		

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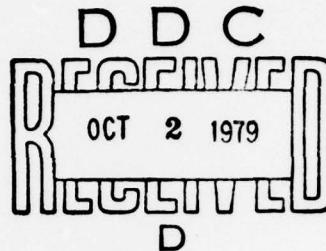
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PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO  
NAPEN-D

Honorable Brendan T. Byrne  
Governor of New Jersey  
Trenton, NJ 08621



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Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Old Morris Canal Dam in Morris County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Old Morris Canal Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate since 25 percent of the Spillway Design Flood--SDF - would overtop the dam. (The SDF, in this instance, is one half of the Probable Maximum Flood.) The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the dam's reduced hazard classification and expectation that failure of the structure would probably result in no loss of life. For the same reasons no further studies or increase of spillway capacity are recommended. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Within 30 days from the date of approval of this report, engineering studies and analyses should be initiated to design and supervise repairs to the undermining and serious erosion at and below the northeast abutment.

b. Within one year from the date of approval of this report, engineering studies and analyses should be performed to:

(1) Design and supervise repairs of the deteriorated concrete in the overflow section of the dam and the trainwalls at the ends of the overflow section.

NAPEN-D

Honorable Brendan T. Byrne

(2) Inspect the spillway for seepage during a period of low flow.

b. Within 30 days from the date of approval of this report, the debris lodged on the southwest end of the spillway crest should be removed.

c. Within three months from the date of approval of this report, a program should be initiated to check the condition of the dam once each month until remedial measures are effected.

d. The following remedial actions should be completed within one year from the date of approval of this report:

(1) Engage a professional engineer qualified in the design and inspection of dams to make a comprehensive technical inspection of the dam once every two years.

(2) Establish a surveillance program for use during and immediately following periods of heavy rainfall, and also a warning program to follow in case of floodflow conditions or imminent dam failure.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman James A. Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

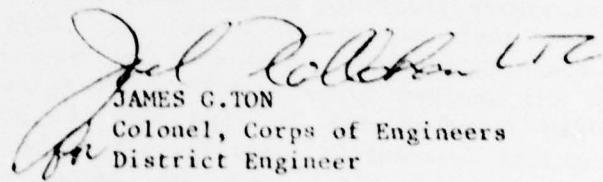
Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

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Honorable Brendan T. Byrne

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,



JAMES G. TON  
Colonel, Corps of Engineers  
District Engineer

1 Incl  
As stated

Copies furnished:  
Dirk C. Hofman, P.E., Deputy Director  
Division of Water Resources  
N.J. Dept. of Environmental Protection  
P.O. Box CN029  
Trenton, NJ 08625

John O'Dowd, Acting Chief  
Bureau of Flood Plain Management  
Division of Water Resources  
N.J. Dept. of Environmental Protection  
P.O. Box CN029  
Trenton, NJ 08625

OLD MORRIS CANAL DAM (NJ00173)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 14 May 1979 by Anderson-Nichols and Co., Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Old Morris Canal Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate since 25 percent of the Spillway Design Flood--SDF - would overtop the dam. (The SDF, in this instance, is one half of the Probable Maximum Flood.) The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the dam's reduced hazard classification and expectation that failure of the structure would probably result in no loss of life. For the same reasons no further studies or increase of spillway capacity are recommended. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Within 30 days from the date of approval of this report, engineering studies and analyses should be initiated to design and supervise repairs to the undermining and serious erosion at and below the northeast abutment.

b. Within one year from the date of approval of this report, engineering studies and analyses should be performed to:

(1) Design and supervise repairs of the deteriorated concrete in the overflow section of the dam and the trainwalls at the ends of the overflow section.

(2) Inspect the spillway for seepage during a period of low flow.

b. Within 30 days from the date of approval of this report, the debris lodged on the southwest end of the spillway crest should be removed.

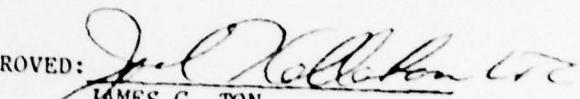
c. Within three months from the date of approval of this report, a program should be initiated to check the condition of the dam once each month until remedial measures are effected.

d. The following remedial actions should be completed within one year from the date of approval of this report:

(1) Engage a professional engineer qualified in the design and inspection of dams to make a comprehensive technical inspection of the dam once every two years.

(2) Establish a surveillance program for use during and immediately following periods of heavy rainfall, and also a warning program to follow in case of floodflow conditions or imminent dam failure.

APPROVED:



JAMES G. TON  
Colonel, Corps of Engineers  
District Engineer

DATE:

12 September 1977

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

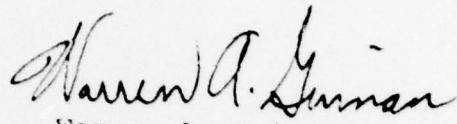
Name of Dam: Old Morris Canal Dam  
ID Number: ID No. NJ00173  
State Located: New Jersey  
County Located: Morris  
Stream: Rockaway River  
River Basin: Passaic  
Date of Inspection: May 14, 1979

ASSESSMENT OF GENERAL CONDITIONS

Old Morris Canal is an old dam of undetermined age and ownership, and is in overall fair condition. The dam is small in size and classified as Significant Hazard. The concrete cap of the visible portion of the crest appears to be in fair condition. It shows evidence of limited erosion and some coarse aggregate is visible. The surface of both training walls at each end of the overflow section is badly spalled and eroded, particularly at the water surface. Immediately downstream of the dam, on the northeast bank of the channel, there is a dry stone masonry training wall which has raveled and collapsed. A large timber, a tree, and several other pieces of debris are lodged on the crest of dam near the southwest training wall. The spillway is capable of passing 12% of PMF without causing overtopping of the dam, and is considered inadequate.

Ownership of the dam should be determined as soon as possible, so that the recommendations below may be carried out. It is recommended that the owner(s) engage a professional engineer, qualified in the design and inspection of dams, to accomplish the following: starting immediately, design and supervise repairs to the undermining and serious erosion at and below the northeast abutment; in the near future, design and supervise repairs to the deteriorated concrete in the overflow section of the dam and the training walls on either side, and inspect the spillway for seepage during a period of low flow. It is further recommended as a part of operating and maintenance procedures: that the debris lodged at the crest of the dam be removed immediately; that beginning very soon, the condition of the dam be checked once each month until remedial measures are effected;

that, in the future a professional engineer qualified in the design and inspection of dams be engaged to make a comprehensive technical inspection of the dam once every two years; and that a surveillance program for use during and immediately following periods of heavy rainfall, and also a warning program to follow in case of floodflow conditions or imminent dam failure be established in the near future.



Warren A. Guinan, P.E.  
Project Manager  
New Jersey No. 16848



14 MAY 1979  
OVERVIEW  
OLD MORRIS CANAL DAM

CONTENTS  
PHASE I INSPECTION REPORT  
OLD MORRIS CANAL DAM N.J. NO. 344 FED ID NO. NJ00173

	<u>Page</u>	
PREFACE		
SECTION 1	PROJECT INFORMATION	
1.1	<u>General</u>	1
1.2	<u>Project Description</u>	1
1.3	<u>Pertinent Data</u>	3
SECTION 2	ENGINEERING DATA	
2.1	<u>Design</u>	5
2.2	<u>Construction</u>	5
2.3	<u>Operation</u>	5
2.4	<u>Evaluation</u>	5
SECTION 3	VISUAL INSPECTION	
3.1	<u>Findings</u>	6
SECTION 4	OPERATIONAL PROCEDURES	
4.1	<u>Procedures</u>	7
4.2	<u>Maintenance of Dam</u>	7
4.3	<u>Maintenance of Operating Facilities</u>	7
4.4	<u>Warning System</u>	7
4.5	<u>Evaluation of Operational Adequacy</u>	7
SECTION 5	HYDROLOGIC/HYDRAULIC	
5.1	<u>Evaluation of Features</u>	8
SECTION 6	STRUCTURAL STABILITY	
6.1	<u>Evaluation of Structural Stability</u>	9
SECTION 7	ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES	
7.1	<u>Dam Assessment</u>	10
7.2	<u>Recommendations/Remedial Measures</u>	10
FIGURES	1. Regional Vicinity Map 2. Essential Project Features	
APPENDICES	1. Check List, Visual Inspection 2. Photographs 3. Hydrologic Computations 4. References	

## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

SECTION 1  
PROJECT INFORMATION

1.1 General

a. Authority. Authority to perform the Phase I Safety Inspection of Old Morris Canal Dam was received from the State of New Jersey, Department of Environmental Protection, Division of Water Resources by letter dated 4 April 1979 under Contract No. FPM-39 dated 28 June 1978. This Authority was given pursuant to the National Dam Inspection Act, Public Law 92-367 and by agreement between the State and the U.S. Army Engineers District, Philadelphia. The inspection discussed herein was performed by Anderson-Nichols & Company, Inc. on 14 May 1979.

b. Purpose. The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to safety of Old Morris Canal Dam and appurtenances based upon available data and visual inspection, and, determine any need for emergency measures and conclude if additional studies, investigations and analyses are necessary and warranted.

1.2 Project Description

a. Description of Dam and Appurtenances. Old Morris Canal Dam is an old (construction date unknown) concrete gravity dam, which is approximately 200 feet long, has a structural height of 18.1 feet and a hydraulic height of 16.5 feet. The free overflow concrete capped spillway is 3.0 feet wide and approximately 146 feet long. The upstream face is of undetermined slope. The downstream face is nearly vertical. The spillway drops 12.5 feet from its crest to the streambed below the dam. It is perpendicular to the southwest abutment for two-thirds of its length and then is bent slightly downstream to its northeast abutment. Both ends of the spillway join concrete abutments which extend as wingwalls for about 20 feet upstream. The southwest abutment joins a mortared stone training wall which extends downstream for approximately 40 feet. The northeast embankment slopes gently upwards for approximately 50 feet and then rises quickly to the level of Highland Avenue which is about 15 feet above the abutment. The embankment beyond the southwest spillway abutment slopes gently upwards for about 50 feet to a junction with a natural slope which rises at 1H:IV. The channel downstream of the dam is steep, rocky and well defined. The pool upstream is surrounded by a municipal park area. The Highland Avenue Bridge, which has one opening 11.5 feet high by 100 feet wide, spans the stream approximately 250 feet upstream of the dam.

b. Location. The dam is located in the Town of Boonton, Morris County, New Jersey on the Rockaway River about 250 feet downstream of the Highland Avenue Bridge. Its coordinates are north latitude  $40^{\circ} 54.5'$  and west longitude  $74^{\circ} 25.2'$ . A location map is shown in Figure 1.

c. Size Classification. Old Morris Canal Dam is classified as being small in size, as defined in the Recommended Guidelines for Safety Inspection of Dams, on the basis of its storage volume of 55 acre-feet which is less than 1000 acre-feet, but more than 50 acre-feet, and its structural height of 18.1 feet which is less than 40 feet.

d. Hazard Classification. Visual inspection of the downstream area shows that a breach of the dam would probably not cause significant damage to structures or threaten lives; however, significant economic loss would be sustained because of the substantial investment in, and heavy use made of the park and recreation area upstream and downstream. The hazard classification of Old Morris Canal Dam is thus Significant.

e. Ownership. Ownership of the dam is unclear. An application and permit for repairing canal headgates at the dam, dated 1939, indicates that the Town of Boonton undertook these repairs as a W.P.A. project. Ownership is not mentioned. More recent correspondence in 1968 and 1969 between the State of New Jersey and the municipalities of Jersey City and the Town of Boonton indicates that the State attempted to resolve the question of ownership but succeeded only in eliciting denials of ownership from both municipalities.

f. Purpose of Dam. The dam was originally designed to control the level of water in a reach of the Old Morris Canal which has since been blocked off. At present the dam serves to maintain the existing water level for recreational and aesthetic use of the adjacent park and swimming area belonging to the Town of Boonton.

g. Design and Construction History. No plans, hydraulic or hydrologic data for the original construction are available. The only available records discuss repairs done to head gates at the inlet of the Old Morris Canal which no longer exists.

h. Normal Operational Procedures. Responsibility for operation of the dam is unclear because of the question of ownership.

1.3 Pertinent Data

a. Drainage Areas - 118.2 square miles

b. Discharge at Damsite (cfs)

Maximum known flood at damsite - unknown

Total spillway capacity at maximum pool elevation  
- 3854.

c. Elevation (ft. above MSL)

Top of dam - 494.0

Maximum pool-design surcharge - 499.4

Recreation pool - 490.6 (at time of inspection)

Spillway crest - 490.6

Streambed at centerline of dam - 477.5

Maximum tailwater (estimated) - 487.0

d. Reservoir (feet)

Length of Maximum pool - 2170

Length of recreation pool (at time of inspection)  
- 1600

e. Storage (acre-feet)

Recreation (at time of inspection)-26.5

Design surcharge - 145

Top of dam - 55

f. Reservoir Surface (acres)

Top of dam - 8.5

Maximum pool - 8.5

Recreation pool (at time of inspection) - 5.5

Spillway crest - 5.2

g. Dam

Type - concrete gravity

Length - 200' ±

Height - hydraulic - 16.5'  
structural - 18.1'

Top width (spillway) - 3.0'

Side slopes - vertical downstream; unknown upstream.

Zoning - unknown

Impervious core - unknown

Cutoff - unknown

Grout curtain - unknown

h. Spillway

Type - concrete weir

Length of weir - 146'

Crest elevation - 490'

Gates - none

U/S Channel - Rockaway River

D/S Channel - Rockaway River

SECTION 2  
ENGINEERING DATA

2.1 Design

No original engineering design data or plans were disclosed. Plans showing proposed repairs to canal headgates, which have since been removed, were prepared by Boonton Town Engineer, A. G. Brohmer, in June 1939.

2.2 Construction

No original construction data were disclosed. August 1941 and July 1942 State Water Policy Commission Inspection reports indicate that repairs to the headgates had been accomplished in an acceptable manner.

2.3 Operation

No engineering operational data were disclosed.

2.4 Evaluation

a. Availability. A search of New Jersey Department of Environmental Protection files, and contact with community officials revealed only a limited amount of recorded information. All disclosed information was retrieved.

b. Adequacy. Because of the limited amount of recorded data available evaluation of this dam was based solely on visual observations.

c. Validity. The only available data pertained to the canal headgates which are no longer in existence.

SECTION 3  
VISUAL INSPECTION

3.1 Findings

a. General. Old Morris Canal Dam is a low, run-of-river dam which impounds a reservoir of small size.

b. Dam. Water was discharging over the overflow section of the dam at the time of the inspection, and it was consequently not possible to determine visually the character and condition of that section. Based on what could be seen beneath the overflowing water close to the abutments, it appears that the overflow section is a stone masonry dam with a concrete cap and upstream facing. The concrete cap near the abutments appears to be in fair condition. It shows evidence of limited erosion and some coarse aggregate is visible. The crest of the overflow section is very straight along each of the two sections of the dogleg alignment. There is a bedrock knob exposed on the downstream face at the break in alignment of the crest and bedrock is also exposed on both sides of the channel downstream of the dam. It appears, therefore, that the overflow section is founded on bedrock. There is a concrete training wall at each end of the overflow section. The surface of both training walls is badly spalled and eroded, particularly at the water surface. Between the northeast end of the dam and the northeast abutment (which is a highway fill) there is a fill which extends upstream and downstream with an essentially horizontal surface. This fill is used as parkland. A large timber, a large log and several other pieces of debris are lodged on the crest of dam near the southwest concrete training wall.

c. Appurtenant Structures. There were no appurtenant structures observed to be associated with this dam.

d. Reservoir Area. An open parkland occupies both banks of the river for several hundred feet upstream of the dam. A children's playground is located on the downstream bank. At the dam the reservoir is filled with sediment up to the crest of the overflow section.

e. Downstream Channel. The bottom of the downstream channel appears to be bedrock covered with large boulders. On the northeast bank of the channel is a dry stone masonry training wall which has raveled and collapsed. A large washout of the fill placed in the former canal was observed on the northeast bank immediately downstream of the end of the overflow section of the dam. Large boulders have been dumped into the washout area. The washout does not appear to be the result of river water action. Trees overhang the downstream channel. The channel itself is wide and unobstructed.

SECTION 4  
OPERATIONAL PROCEDURES

4.1 Procedures

No formal operating procedures were disclosed.

4.2 Maintenance of Dam

No formal maintenance procedures for the dam were disclosed.

4.3 Maintenance of Operating Facilities

No formal maintenance procedures for the operating facilities were disclosed.

4.4 Warning System

No description of any warning system was disclosed.

4.5 Evaluation of Operational Adequacy

Because of the lack of operation and maintenance procedures the remedial measures described in Section 7.2 c. should be implemented as prescribed.

SECTION 5  
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

- a. Design Data. Because no data were disclosed an evaluation could not be performed.
- b. Experience Data. No experience data were disclosed.
- c. Visual Observation. No visible evidence of damage to the structure caused by overtopping was observed. At the time of inspection water approximately 0.6 foot deep was flowing over the spillway crest.
- d. Overtopping Potential. The hydraulic/hydrologic evaluation for Old Morris Canal Dam is based on a spillway design flood (SDF) equal to one-half the Probable Maximum Flood (PMF) in accordance with the range of test floods given in the evaluation guidelines for dams classified as significant hazard and small in size. The outflow from Powerville Dam which is 0.7 mile above Old Morris Canal Dam on the Rockaway River was used as the inflow hydrograph. The PMF for Powerville Dam was determined by application of the Snyder unit hydrograph procedure to a 48-hour PMP storm of 22.2 inches (for 200 square miles) adjusted as specified in Hydrometeorological Report No. 33.

Hydrologic computations are given in Appendix 3. The routed half-PMF peak discharge for the subject watershed is 16,335 cfs.

The minimum elevation of the dam allows 4.0 feet of depth in the spillway before overtopping begins. Under this head the spillway capacity is 3854 cfs which is less than the half-PMF.

The small storage volume available compared to discharge, as with most run-of-river dams, causes insignificant reduction in reservoir inflow versus outflow through routing. Calculations indicate that Old Morris Canal Dam will be overtopped for 57 hours to a maximum depth of 5.42 feet. It is estimated that the dam can pass approximately 12% of the PMF or 24% of the required SDF. Any overtopping of the spillway abutments could pose a serious threat to the integrity of the structure because of the fill washout downstream of the northeast abutment. The spillway is judged to be inadequate.

SECTION 6  
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The visual observations that could be made were very limited because water was flowing over the overflow section of the dam at the time of the inspection. The excellent alignment of the crest of the overflow section of the dam indicates that it has not suffered obvious deformation under past loading conditions. Erosion of the concrete and exposure of coarse aggregate in the concrete cap of the overflow section, if not corrected, will eventually result in loss of structural stability of the concrete. Spalling and erosion of the concrete training walls at each end of the overflow section, especially at the water line, is very serious already, and could lead to collapse of the walls. The large washout in the fill that comprises the northeast bank of the channel immediately downstream of the overflow section, if uncorrected, could lead to failure of the embankment section between the northeast abutment and the northeast end of the overflow section of the dam. Based on the visual inspection alone it is not possible to determine the character of the foundation, the character of the interior of the cross section, or the shape of the upstream face below the level of sediment in the reservoir next to the dam. Therefore, it is not possible to evaluate the factor of safety of the dam against sliding or overturning.

b. Design and Construction Data. No design and construction data pertinent to the structural stability were disclosed.

c. Operating Records. No operating records pertinent to the structural stability were disclosed.

d. Post-Construction Changes. Available records indicate that canal gates and a canal drainage gate at Old Morris Canal Dam were repaired sometime between 1939 and 1941. The canal and gate structures have obviously been removed and backfilled since that time.

e. Seismic Stability. Old Morris Canal Dam is in Seismic Zone 1 and in accordance with the recommended Phase I guidelines does not warrant seismic analysis.

SECTION 7  
ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

- a. Condition. Old Morris Canal Dam is of undetermined age and is in fair overall condition.
- b. Adequacy of Information. The information available is such that the assessment of the dam must be based primarily on the results of the visual inspection.
- c. Urgency. The recommendations made in Section 7.2 a. and the operating and maintenance procedures in 7.2 c. should be implemented by the owner as prescribed.
- d. Necessity for Additional Data/Evaluation. The information available from the visual inspection is adequate to identify the potential problems which have been outlined in Sections 5 and 6. These problems require the attention of a professional engineer who should make additional engineering studies to design or specify remedial measures to rectify the problems. If left unattended, the problems could lead to instability of the structure.

7.2 Recommendations/Remedial Measures

The question of ownership must be resolved so that the following recommended remedial measures and operating and maintenance procedures may be undertaken.

- a. Recommendations. The owner(s) should retain the services of a professional engineer qualified in the design and inspection of dams, to accomplish the following:

Immediately repair the large washout of the fill on the left bank of the channel downstream of the overflow section of the dam.

In the near future:

(1) Design and supervise repairs of the deteriorated concrete in the overflow section of the dam and the train-walls at the ends of the overflow section.

(2) Inspect the spillway for seepage during a period of low flow.

b. Alternatives. Drain the reservoir and breach the dam.

c. Operating and Maintenance Procedures. The owner(s) should:

(1) Remove the debris lodged on the southwest end of the spillway crest. This should be done immediately.

(2) Check the condition of the dam once each month until remedial measures are effected. This should be started very soon.

(3) Engage a professional engineer qualified in the design and inspection of dams to make a comprehensive technical inspection of the dam once every two years. This should be started in the future.

(4) Establish a surveillance program for use during and immediately following periods of heavy rainfall, and also a warning program to follow in case of floodflow conditions or imminent dam failure. This should be done in the near future.



Anderson-Nichols & Co., Inc.

BOSTON

MASSACHUSETTS

U.S. ARMY ENGINEER DIST. PHILADELPHIA  
CORPS OF ENGINEERS  
PHILADELPHIA, PA.

### NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

## OLD MORRIS CANAL DAM LOCATION MAP

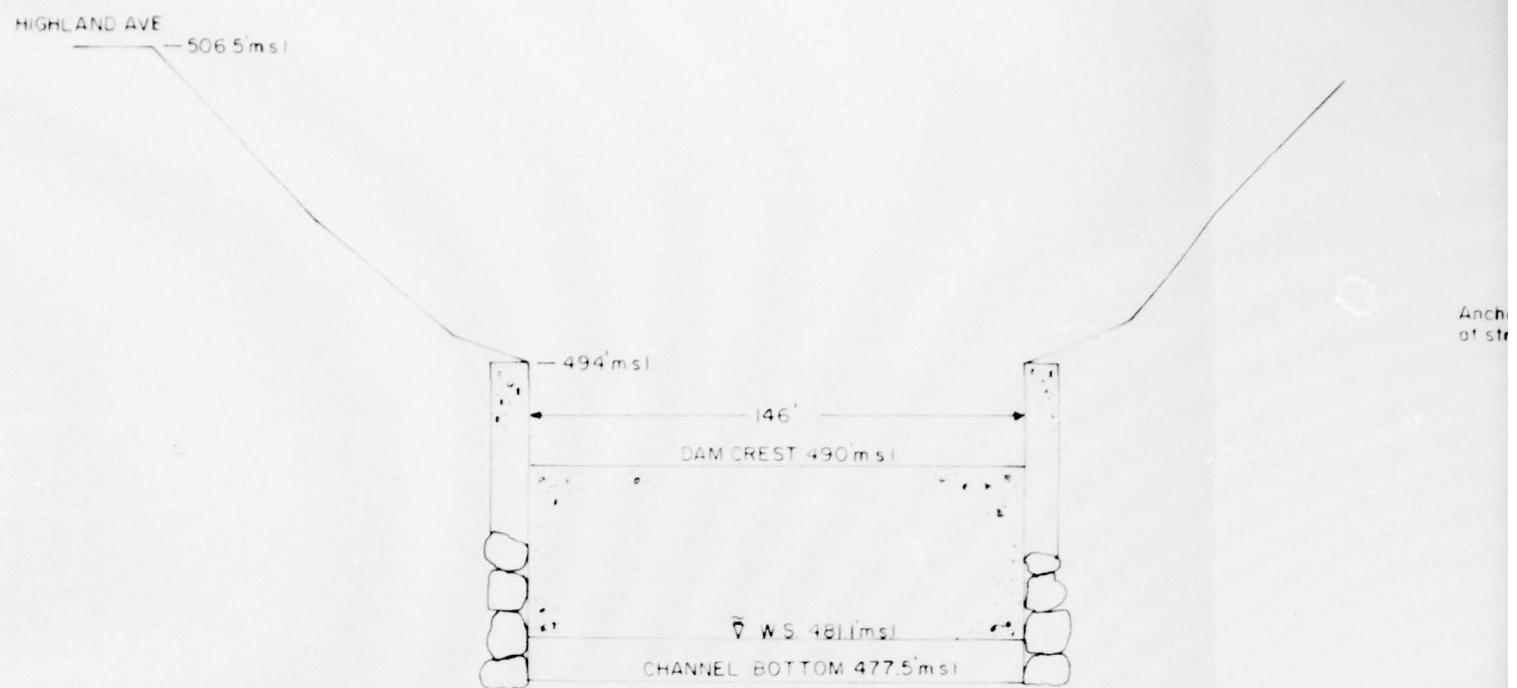
ROCKAWAY RIVER

NEW JERSEY

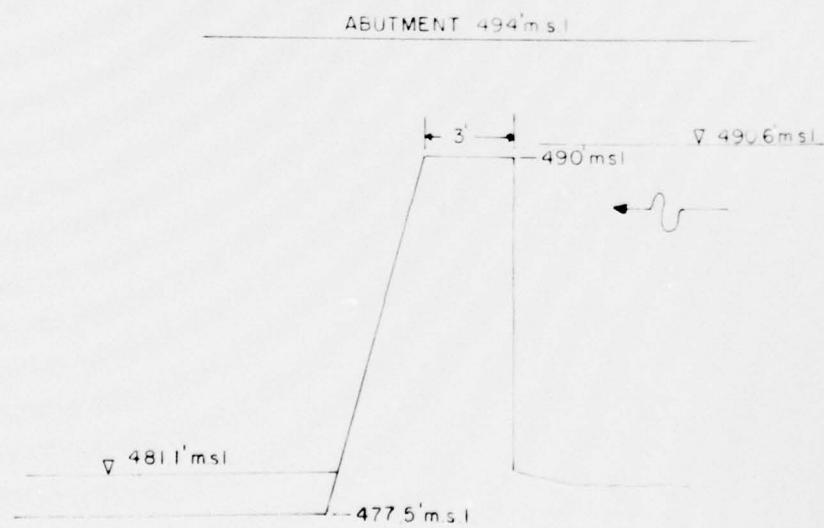
SCALE SEE BAR SCALE
DATE JULY 1979

MAP BASED ON STATE OF NEW JERSEY  
OFFICIAL HIGHWAY MAP AND GUIDE.

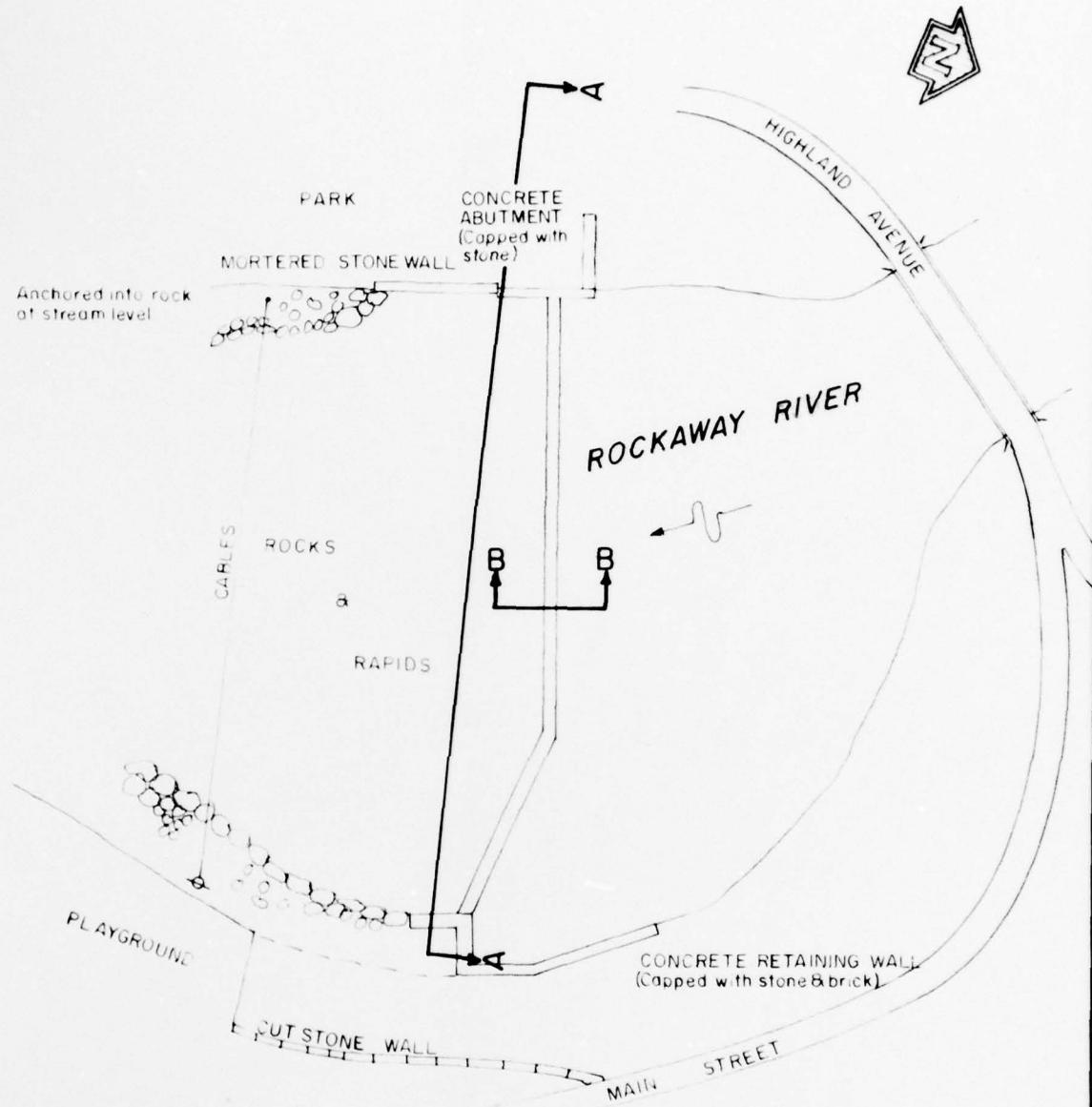
FIGURE-1



SPILLWAY ELEVATION A-A



SPILLWAY SECTION B-B



## PLAN

2

DATA FROM FIELD INSPECTION MAY 14, 1979

Anderson-Nichols & Co., Inc.

BOSTON

U.S. ARMY ENGINEER DIST PHILADELPHIA  
CORPS OF ENGINEERS  
PHILADELPHIA, PA

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

## OLD MORRIS CANAL DAM

ROCKAWAY RIVER

NEW JERSEY

SCALE: NOT TO SCALE
DATE: JULY 1979

FIGURE 2

APPENDIX 1

CHECKLIST

VISUAL INSPECTION

OLD MORRIS CANAL DAM

Check List  
Visual Inspection  
Phase 1

Name	Dam	Old Morris Canal Dam	County	Morris	State	New Jersey	Coordinates	N.J. D.E.P.
Date(s)	Inspection	5/14/79	Weather	Cool, rainy	Temperature	55°		
Pool Elevation at Time of Inspection		490.6	MSL	Tailwater at Time of Inspection	481.1	MSL		

Inspection Personnel:

Warren Guinan  
Stephen Gilman  
David Deane

Gilman & Hirschfeld  
Recorder

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEEPAGE OR LEAKAGE	None observed.	Water flowing over crest precluded inspection of spillway for seepage.
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS		No indication of movement.
DRAINS		None observed.
WATER PASSAGES		None observed.
FOUNDATION		Appears to be bedrock (based on bedrock exposures on sides of channel downstream of dam).

## CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF		OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	<u>Left Abutment:</u>	Wall surface badly eroded and spalled wall undermined @ water surface.	Concrete undermining should be repaired.
	<u>Right Abutment:</u>	Same as left. Stone masonry training wall - 40' D/S is raveling.	Wall should be repaired.
STRUCTURAL CRACKING		Some hairline cracking.	
VERTICAL AND HORIZONTAL ALIGNMENT		No indication of movement. No indication of distress.	
MONOLITH JOINTS		None visible.	
CONSTRUCTION JOINTS		None visible.	

EMBANKMENT - From training wall on left end  
of overflow spillway to highway

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Large washout of bank immediately downstream of left end of overflow spillway. Large boulders dumped into washout area.	Washout should be repaired and bank protected against erosion. May be wash out of fill placed in old canal.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	No crest as such. Embankment consists of fill with level surface.	
RIPRAP FAILURES	No riprap.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
RAILINGS	None	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	See "Sloughing or erosion..." above.	
ANY NOTICEABLE SEEPAGE	None observed.	
STAFF GAGE AND RECORDER	None observed.	
DRAINS	None observed.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF

	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Downstream face - not visible due to flow over dam. Top surface flat. Visible portions of top and abutments in fair condition. Limited surface erosion - coarse aggregate visible. Right side - downstream face - stone masonry with concrete cap crest of dam appears very straight.	Needs inspection when low water flows over surface.
APPROACH CHANNEL	Broad and unobstructed. Sediment fills channel to upstream edge of weir crest. Bridge across channel a short distance upstream.	Sediment deposit has built up at spillway but drops off sharply within 10 feet upstream.
DISCHARGE CHANNEL	Boulders and bedrock. Trees overhanging channel.	No need to remove trees because channel is broad and unobstructed.
BRIDGE AND PIERS OVER SPILLWAY	None.	

INSTRUMENTATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VISUAL EXAMINATION		
MONUMENTATION/SURVEYS	None observed	
OBSERVATION WELLS	None observed	
WEIRS	None observed	
PIEZOMETERS	None observed	
OTHER	None observed	

VISUAL EXAMINATION OF	RESERVOIR	REMARKS OR RECOMMENDATIONS
OBSERVATIONS		
SLOPES	Grassy, gentle slopes between dam and bridge. Municipal park area.	
SEDIMENTATION	Channel filled with sediment to upstream edge of spillway weir crest for a short distance upstream.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
	Good. Bedrock and boulders. Trees overhanging channel.	
SLOPES	Bedrock and soil slopes.	
APPROXIMATE NO. OF HOMES AND POPULATION	Several industrial buildings approximately $\frac{1}{2}$ mile downstream. No permanent population.	

CHECK LIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	No original plans were disclosed. Plans for this report were developed from visual inspection.
REGIONAL VICINITY MAP	Prepared for this report.
CONSTRUCTION HISTORY	The only available records discuss repairs done to gates at the inlet of the Old Morris Canal which no longer exists.
TYPICAL SECTIONS OF DAM	Prepared for this report from visual inspection.
HYDROLOGIC/HYDRAULIC DATA	No original data were disclosed.
OUTLETS - PLAN	Not applicable.
- DETAILS	
- CONSTRAINTS	
- DISCHARGE RATINGS	
SPINFALL/RESERVOIR RECORDS	None disclosed.

ITEM	REMARKS
MONITORING SERVICES	Unknown
MODIFICATIONS	August 1941 and July 1942 State Water Policy Commission inspection reports indicate that repairs to the headgates had been done. The headgates no longer exist.
HIGH POOL RECORDS	None disclosed.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	The only available records discuss repairs done to headgates at the inlet of the Old Morris Canal.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None disclosed.
MAINTENANCE OPERATION RECORDS	None disclosed.

ITEM	REMARKS
DESIGN REPORTS	None disclosed.
GEOLOGY REPORTS	None disclosed.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None disclosed.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None disclosed.
POST-CONSTRUCTION SURVEYS OF DAM	None disclosed.
BORROW SOURCES	Unknown

<u>ITEM</u>	<u>REMARKS</u>
SPILLWAY PLAN	No original plans were disclosed.
SECTIONS	Typical section of spillway was developed for this report
DETAILS	from visual inspection.
OPERATING EQUIPMENT	None.
PLANS & DETAILS	

CHECK LIST  
HYDROLOGIC AND HYDRAULIC DATA  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 118 square miles - hilly

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 26.5 acre-feet

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 55 acre-feet

ELEVATION MAXIMUM DESIGN POOL: 499.4'

ELEVATION TOP DAM: 494'

CREST: free overflow concrete capped spillway

- a. Elevation 490'
- b. Type concrete weir
- c. Width 5.2'
- d. Length 146'
- e. Location Spillover central, perpendicular to river flow
- f. Number and Type of Gates none

OUTLET WORKS: none

- a. Type
- b. Location
- c. Entrance Inverts
- d. Exit Inverts
- e. Emergency Draindown Facilities

HYDROMETEORLOGICAL GAGES: none

- a. Type
- b. Location
- c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 3854. cfs

APPENDIX 2

PHOTOGRAPHS

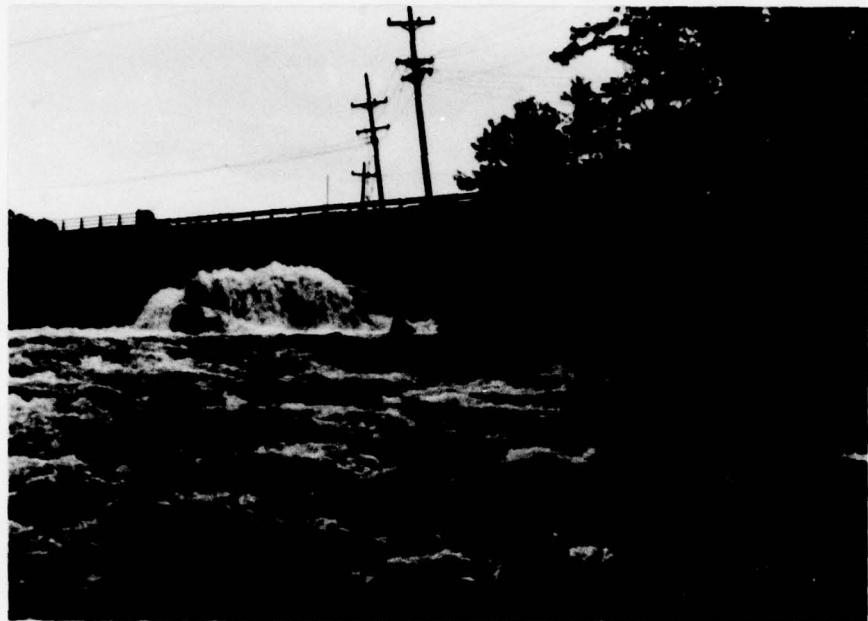
OLD MORRIS CANAL DAM



14 MAY 1979

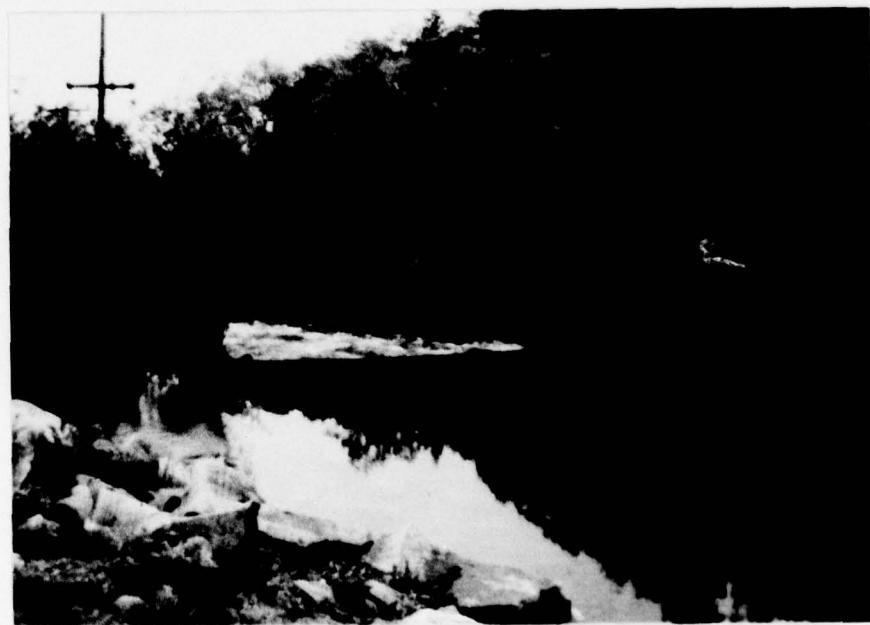
VIEW OF CREST AND DOWNSTREAM FACE LOOKING SOUTHWEST

OLD MORRIS CANAL DAM



14 MAY 1979

VIEW OF NORTHEAST SIDE OF SPILLWAY FROM DOWNSTREAM



14 MAY 1979

VIEW OF CREST FROM UPSTREAM SIDE

OLD MORRIS CANAL DAM



14 MAY 1979

UPSTREAM POOL LOOKING NORTH TOWARDS HIGHLAND AVE.  
BRIDGE



14 MAY 1979

UPSTREAM POOL LOOKING NORTHEAST TOWARDS HIGHLAND AVE.

OLD MORRIS CANAL DAM



14 MAY 1979

VIEW DOWNSTREAM FROM HIGHLAND AVE. BRIDGE



14 MAY 1979

UPSTREAM POOL ABOVE HIGHLAND AVE. BRIDGE LOOKING  
NORTH

OLD MORRIS CANAL DAM



14 MAY 1979

UPSTREAM SIDE OF SOUTHWEST ABUTMENT



14 MAY 1979

DOWNTSTREAM SIDE OF SOUTHWEST ABUTMENT

OLD MORRIS CANAL DAM



14 MAY 1979

UPSTREAM SIDE OF NORTHEAST ABUTMENT



14 MAY 1979

DOWNSTREAM SIDE OF NORTHEAST ABUTMENT

OLD MORRIS CANAL DAM



14 MAY 1979

NORTHEAST ABUTMENT LOOKING NORTHEAST



14 MAY 1979

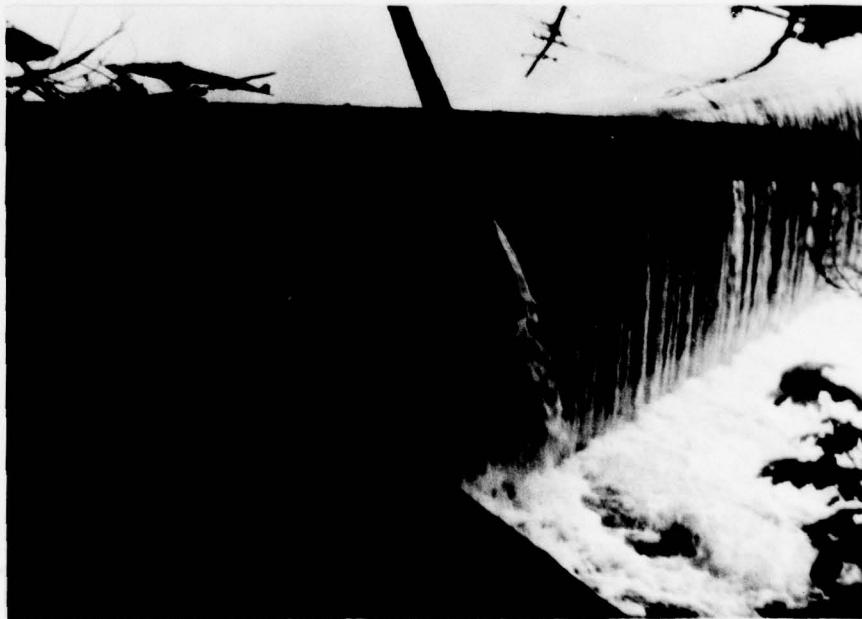
WASHOUT AREA DOWNSTREAM OF NORTHWEST ABUTMENT

OLD MORRIS CANAL DAM



14 MAY 1979

TOP VIEW OF WASHOUT AREA DOWNSTREAM NORTHEAST ABUTMENT



14 MAY 1979

DEBRIS ON TOP OF SOUTHWEST ABUTMENT

OLD MORRIS CANAL DAM

APPENDIX 3  
HYDROLOGIC COMPUTATIONS  
OLD MORRIS CANAL DAM

ITEM	MONI	MODI	HIGH	POST STUD	PRIOR DESC REPO	MAIN OPER REC
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1-11

Anderson-Nichols &amp; Company, Inc.

Subject 45

Sheet No. 1 of 7

JOB NO. 3290-06 OLD MORRIS CANAL DAM

Date 7-1-72  
Computed  
Checked EASARES 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29  
N. SCALE

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HYDROLOGICAL COMPUTATIONS

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OLD MORRIS CANAL DAM

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LOCATION : MORRIS COUNTY , N. J.

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DRAINAGE AREA : 118. SQ.MILES

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EVALUATION CRITERIA : SIZE - SMALL  
HAZARD - SIGNIFICANT

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APPROACH : THE OUTFLOW FROM POWERVILLE DAM  
IS USED AS THE INFLOW HYDROGRAPH.

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ANDERSON - NICHOLS & CO. INC.

JOC # 2290 - 06

06 - 12 - 79

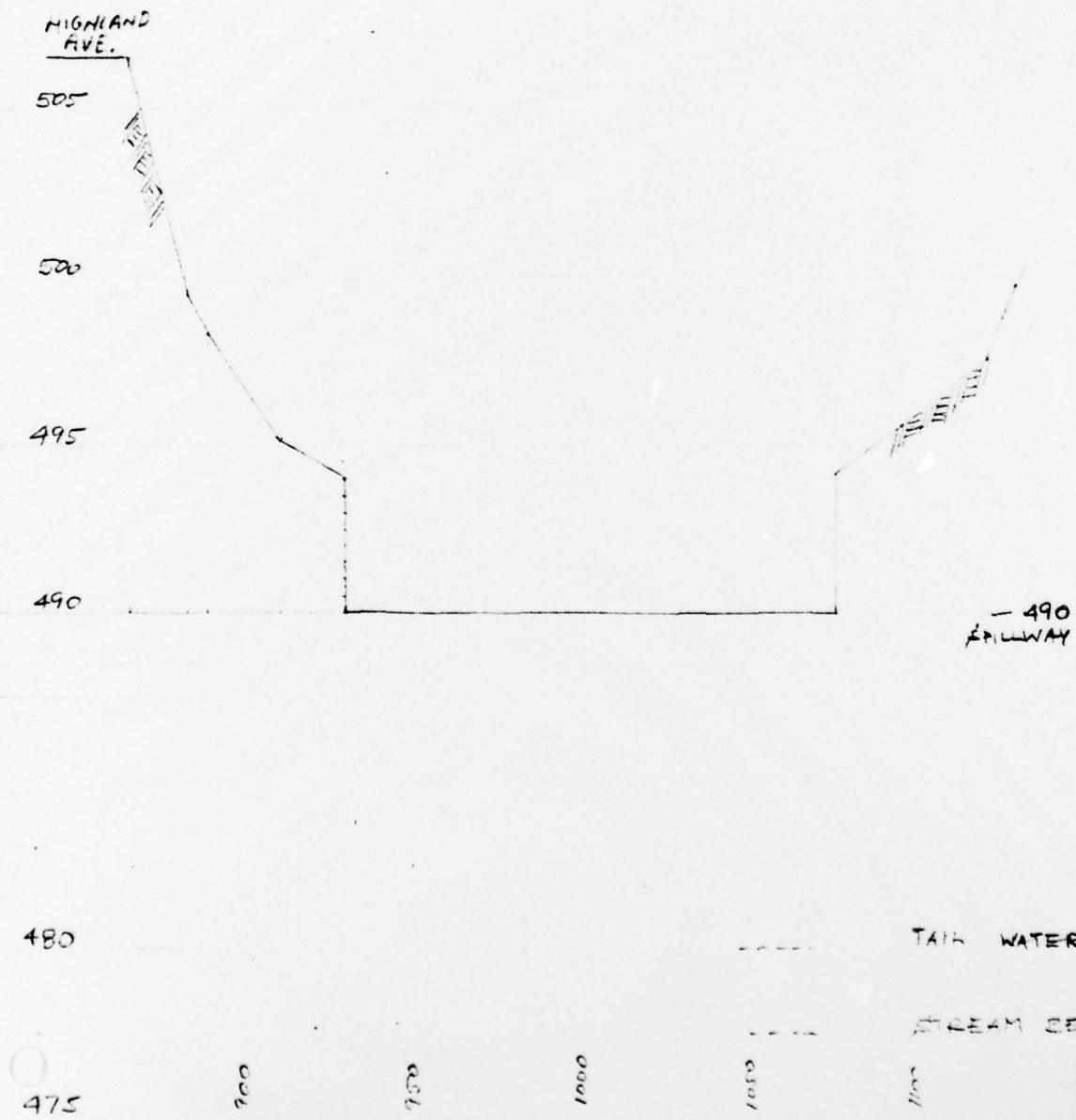
COMPLETED 27 JUN

CHKD BY: FDD

F. 2 of 7

HOR. SCALE : 1" - 50'  
VER SCALE : 1" - 5'

OLD MORRIS CANAL DAM - X-SECTION



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Subject HS4Sheet No. 3 of 7  
Date Oct - 12 - 67  
Computed 100%  
Checked JANJOB NO. 3290-06RES 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29  
. SCALOLD MORRIS CANAL DAM - RATING CURVE CALC.

2  
3  
4  $C = 2.2$  FOR STILLWAY      TOTAL  
5      Q  
6

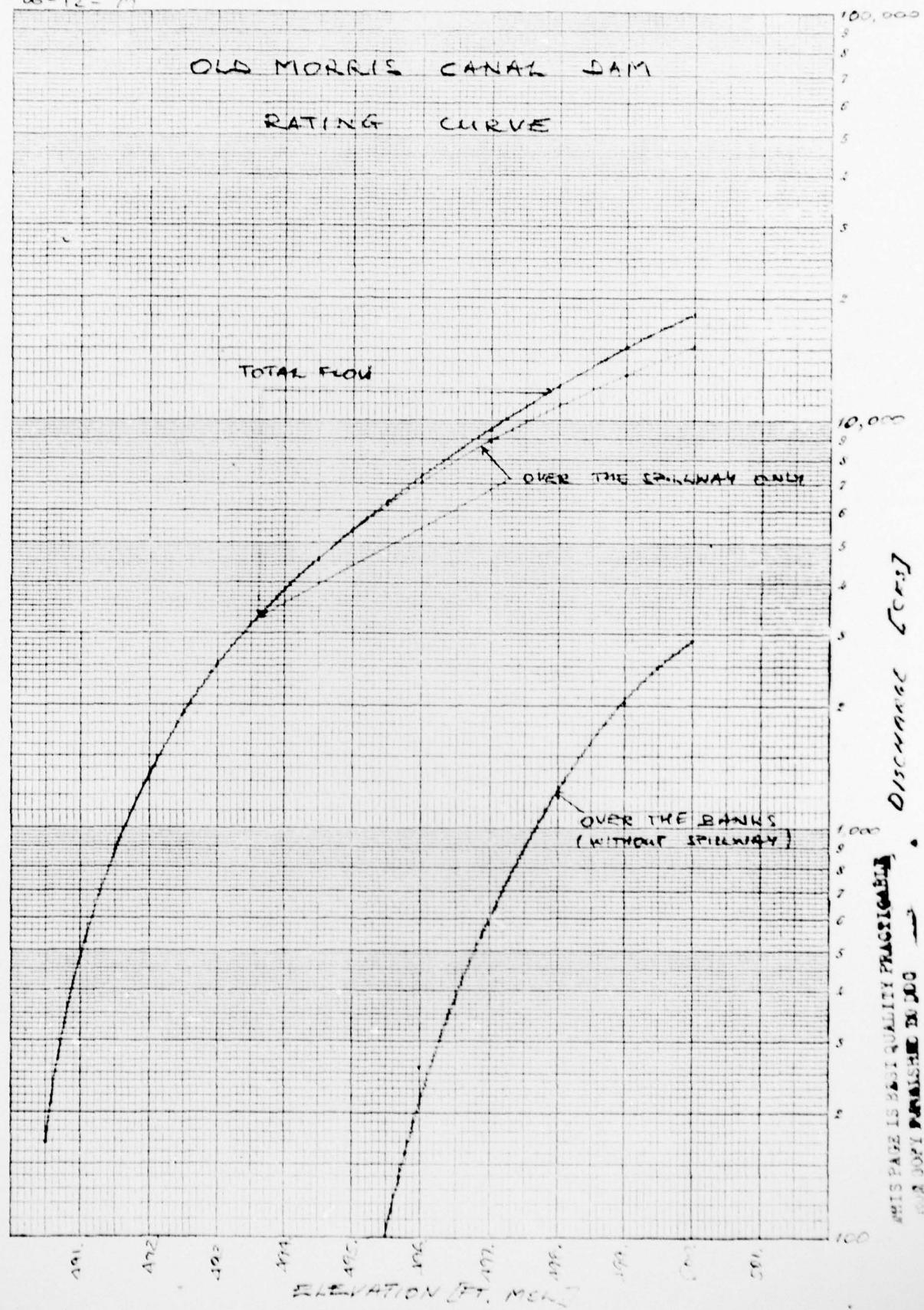
7	$Q = 2.3 + 146 \cdot 0.5^{3/2}$	- 170.	- 170.
8	$1.0^{3/2}$	- 482	- 482.
9	$1.5^{3/2}$	- 885	OVERFALLS - 885.
10	$2.0^{3/2}$	- 1363	- 1363.
11	$2.5^{3/2}$	- 1904	- 1904.
12	$3.0^{3/2}$	- 2504	- 2504.
13	$3.5^{3/2}$	- 3155	- 3155.
14	$4.0^{3/2}$	- 3854	- 3854
15	$4.5^{3/2}$	= 4599	$28 \cdot 5.0 \cdot 0.5^{3/2} = 5.0$ - 4,664
16	$5.0^{3/2}$	- 5286	$16 \cdot 1.0 = 16$ - 5,286
17	$5.5^{3/2}$	- 6215	$20 \cdot 1.5 = 30$ - 103 - 6,318
18	$6.0^{3/2}$	- 7081	$33 \cdot 2.0 = 66$ - 261 - 7,242
19	$7.0^{3/2}$	- 8923	$41 \cdot 3.0 = 123$ - 596 - 9,519
20	$8.0^{3/2}$	- 10902	$55 \cdot 4.0 = 220$ - 1232 - 12,132
21	$9.0^{3/2}$	- 13009	$65 \cdot 5.0 = 325$ - 2035 - 15,044
22	$10.0^{3/2}$	- 15236	$70 \cdot 6.0 = 420$ - 2880 - 18,116
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ANDERSON-NICHOLS CO., INC.

JOLE NO. 3290-06  
06-12-77

COMPUTED BY  
CHAS BY R.D.

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Subject H. S. 11Sheet No. 5 of 7  
Date 06-12-77  
Computed 20  
Checked FCCJOB NO. 3290-06RES 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29  
. SCAL2 OLD MORRIS CANAL DAM  
34 STORAGE CALCULATIONS  
5

7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Z.	H.	L.	STREAM WIDTH										STORAGE (cu-yd.)									
490.	9.	1500	150										23.2									
491.	10.	1670	150										29.7									
492.	11.	1830	150										34.6									
493.	12.	2000	160										44.									
494.	13.	2170	170										55.									
495.	14.	2330	180										67.4									
496.	15.	2500	190										81.8									
497.	16.	2670	200										98.									
498.	17.	2830	210										116.									
499.	18.	3000	220										136.4									

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Subject W.C. 1Sheet No. 6 of 7  
Date 05-15-79  
Computed \_\_\_\_\_  
Checked EJGJOB NO. 3290 - 06ARES 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29  
N. SCA

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OLD MORRIS CANAL DAM  
SUMMARY

ELEV.	H (ft) ABOVE THE SPILLWAY	Q [cu ft]	STORAGE [AC - FT]
490.	0.	0.	22.2
490.5	.5	170.	—
491.	1.0	482.	28.7
491.5	1.5	885.	—
492.0	2.0	1363.	34.6
492.5	2.5	1904.	—
493.	3.0	2504.	44.
493.5	3.5	3155.	—
494.	4.0	3854.	55.
494.5	4.5	4,604	—
495.0	5.0	5,431	67.4
495.5	5.5	6,213	—
496.0	6.0	7,342	81.8
497.0	7.0	9,519	96.
498.0	8.0	12,134	116.
499.0	9.0	15,044	136.4
2000	10.0	18,116	—

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FROM KEY DRAWING BY E.J.G.

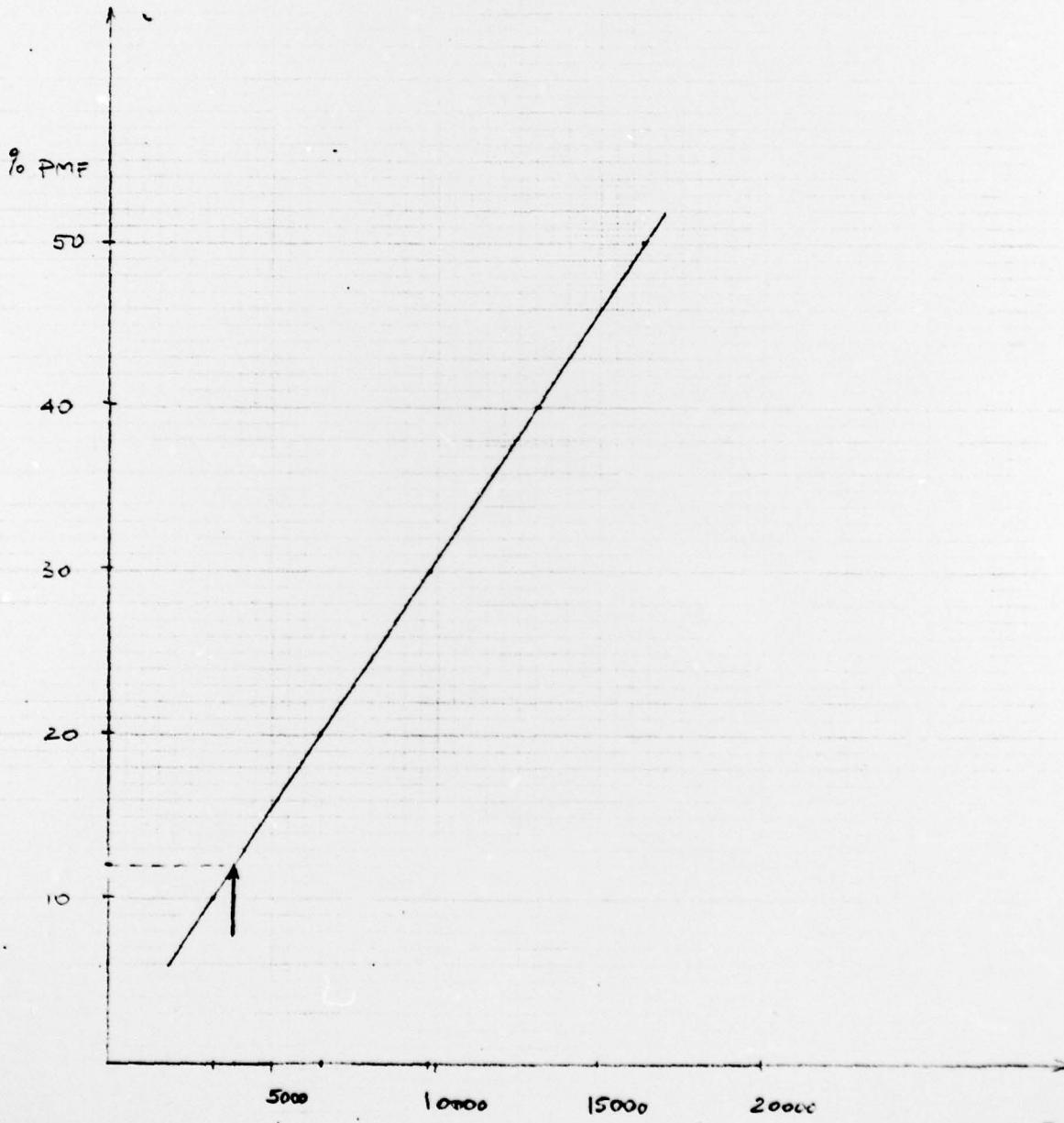
37

ANDERSON - NICHOLS & CO., INC.  
SUBJECT: H.G.P.

COMPUTED BY: D.C. CHOI FDD  
DATE: 06-18-74

p. 7 of 7

OLD MORRIE CANAL DAM



DAM OVERTOPS AT APPROX. EL. 494.0

WITH Q - 3854 cfs.

∴ DAM CAN PASS ~ 12% of PMF

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NO COPY PRECISION TO 100%

OUTFLOW [cfs]

HEC-1 OUTPUT  
OLD MORRIS CANAL DAM

1 ALJNR 3290-06 OLD MORRIS CANAL TOWN OF RUTON N.J. N.J. #344 U.S. #173  
 2 OVERTOPPING ANALYSIS ANDERSON-NICHOLS & CO. INC. CONCORD, N.H.  
 3 A30,1,0,2,0,3,0,4 AND 0.5 MULTIFLES OF RMF FROM 48-HOUR FMP

	R	120	1	0	0	0	0	0	0	0	0
1	n1	5									
2	J	1	5	1							
3	J	.2	.4	.6	.8						
4	K	0	A1								
5	K1DEVELOP INFLOW HYDROGRAPH FOR OLD MORRIS CANAL DAM										
6	M	-1	110.2								
7	N	1.33	89	104	99	100	100	100	100	100	100
8	N	100	100	100	100	100	103	115	138	172	213
9	N	256	304	354	407	462	516	566	611	650	692
10	N	709	731	751	764	774	784	815	901	1076	1400
11	N	1944	2722	3654	4705	5725	7156	8510	9725	11082	12242
12	N	13369	14279	15089	15684	16125	16328	16339	16109	15218	15236
13	N	14741	14249	13775	13310	12862	12426	12005	11597	11206	10825
14	N	10460	10104	9763	9432	9113	8804	8507	8214	7936	7668
15	N	7409	7159	6918	6685	6459	6249	6037	5835	5638	5450
16	N	5266	5087	4917	4751	4595	4453	4297	4158	4018	3885
17	N	3755	3630	3509	3389	3278	3169	3064	2963	2865	2771
18	N	2679	2592	2506	2424	2345	2251	2163	2090	2019	1955
19	K	1	A2								
20	K1OVERTOPPING ANALYSIS										
21	Y										
22	Y1										
23	Y2										
24	Y3										
25	Y4										
26	Y4	490.	490.5	491.	491.5	492.	492.5	493.	493.5	494.	494.5
27	Y4	495.	495.5	496.	497.	498.	499.	500.			
28	Y5	0.	170.	482.	885.	1363.	1904.	2504.	3155.	3854.	4604.
29	Y5	5A31.	6318.	7342.	9512.	12134.	15044.	18116.			
30	Y5	23.2	28.7	34.6	44.	55.	67.4	81.8			
31	Y5	490.	491.	492.	493.	494.	495.	496.	497.	498.	499.
32	Y5	490.	491.	492.	493.	494.	495.	496.	497.	498.	499.
33	Y5	490.	491.	492.	493.	494.	495.	496.	497.	498.	499.
34	Y5	494.									
35	K	99									

1 PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT  
ROUTE HYDROGRAPH TO  
END OF NETWORK

THIS PAGE IS BEST QUALITY PRACTICABLE  
FROM COPY PUBLISHED BY DDC

FLOOD HYDROGRAPH PACKAGE (HEC-1)  
DAM SAFETY VERSION JULY 1978  
LAST MODIFICATION 26 FEB 79

RUN DATE# 79/06/15.  
TIME# 12.47.13.

JOB 3290-06 OLD MORRIS CANAL DAM TOWN OF BODON, N.J. N.J. #344 U.S.#1173  
OVERTIPPING ANALYSIS—ANDERSON-NICHOLS & CO., INC.—CONCORD, N.H.  
0.1-0.2-0.3-0.4 AND 0.5 MULTIFLIES OF FMF FROM 48-HOUR PMF

NO	NHR	NMIN	IDAY	JOF SELECT	1MIN	METRC	IPLT	IPRT	INSTAN	0
120	1	0	0	JOFER	0	0	0	0	0	0
				NWT	0	0	0	0	0	0
				LROFT	0	0	0	0	0	0
				5	0	0	0	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED  
NFLAN = 1 NRTIO = 5 LRTIO = 1

卷之三

SUB-AREA RUNOFF COMPUTATION

**DEVELOP INFLOW HYDROGRAPH FOR OLD MORRIS CANAL DAM**

ISTAO	ICOMP	IECON	ITATE	JPLT	JFRT	INAME	IStage	IAUTO
A1	0	0	0	0	1	1	0	0

IHYONG -1	TUNG 0	TAREA 118.20	HYDROGRAPH DATA			ISNOW 0.000	ISAME 0	LOCAL 1	0
			SNAF 0.00	TRSLA 118.20	TRSPC .87				
INPUT HYDROGRAPH									
89.	104.	99.	100.	100.	100.	100.	100.	100.	100.
100.	100.	100.	100.	103.	115.	138.	172.	211.	211.
304.	354.	407.	462.	516.	566.	611.	650.	687.	687.
731.	751.	764.	774.	784.	815.	901.	1076.	1401.	1401.
2722.	3654.	4705.	5975.	7156.	8510.	9725.	11082.	12241.	12241.
14279.	15089.	15684.	16125.	16338.	16339.	16109.	15718.	15236.	15236.
14249.	13775.	13310.	12862.	12426.	12005.	11597.	11206.	10824.	10824.
10104.	9763.	9432.	9113.	8804.	8507.	8214.	7936.	7666.	7666.
7159.	6918.	6685.	6459.	6249.	6037.	5835.	5638.	5455.	5455.
5087.	4917.	4751.	4595.	4433.	4297.	4158.	4018.	3888.	3888.
34630.	3509.	3389.	3278.	3162.	3064.	2963.	2865.	2777.	2777.
2592.	2506.	2424.	2345.	2241.	2163.	2090.	2039.	1955.	1955.

CFS	16339.	16013.	13540.	8143.	618406.
CMS	463.	453.	383.	231.	17511.
INCHES		1.26	4.26	7.69	8.11
MM		32.01	108.27	195.34	206.03
AC-FIT		7900.	26857.	48457.	51108.
TRUONG CHI		9700.	31128.	59271.	63041.

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## OVERTOPPING ANALYSIS

## HYDROGRAPH ROUTING

	ISTAD	ICOMP	IECON	ITAFE	JFLT	JFRT	I NAME	I STAGE	I AUTO
	A2	1	0	0	0	1	1	0	0
QLOSS	CLOSS	AUG	IRES	ROUTING DATA					
0.0	0.000	0.00	ISAME	ROUTING DATA					
NSTFS	NSTDL	LAG	AMSKR	X	TSK	STORA	ISFRAT		LSTR
0	0	0	0.000	0.000	0.000	-490.	-490.	-1	0
STAGE	490.00	490.50	491.00	491.50	492.00	492.50	493.00	493.50	
	493.00	493.50	495.00	497.00	498.00	499.00	500.00	500.00	494.50
FLOW	0.00	170.00	482.00	885.00	1363.00	1904.00	2504.00	3155.00	3854.00
	5431.00	6318.00	7342.00	9319.00	12134.00	15044.00	18116.00	18116.00	4604.00
CAFACITY=	23.	29.	35.	44.	55.	67.	82.	98.	116.
ELEVATION=	490.	491.	492.	493.	494.	495.	496.	497.	136.
CREL	SPWID	CODW	EXPW	ELEV	COOL	CAREA	EXPL		
490.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
TDFEL	CODD	DAMDATA	EXFD	DAMWID					
	494.0	0.0	0.0	0.					

NSTFS

NSTDL

LAG

AMSKR

X

TSK

STORA

ISFRAT

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STATION A2, PLAN 1, RATIO 5  
END-OF-PERIOD HYDROGRAPH ORDINATES

		OUTFLOW										
194.	71.	107.	99.	100.	100.	100.	100.	100.	100.	100.	100.	100.
100.	100.	100.	100.	100.	102.	112.	112.	112.	112.	113.	115.	110.
231.	299.	348.	401.	456.	511.	561.	607.	647.	677.	707.	737.	707.
706.	729.	749.	763.	773.	783.	811.	811.	811.	811.	811.	811.	811.
1870.	2646.	3550.	4601.	587.	7065.	8369.	9639.	10950.	12171.	13691.	15287.	15287.
13256.	14227.	15008.	15660.	16081.	16331.	16335.	16144.	15797.	15287.	15287.	15287.	15287.
14779.	14293.	13812.	13351.	12898.	12464.	12040.	11630.	11238.	10850.	10850.	10850.	10850.
10490.	10134.	9791.	9462.	9141.	8832.	8533.	8241.	7960.	7692.	7390.	7050.	7050.
7432.	7180.	6938.	6705.	6478.	6267.	6060.	5853.	5658.	5462.	5262.	5062.	5062.
5293.	5103.	4932.	4766.	4609.	4468.	4313.	4170.	4033.	3897.	3781.	3675.	3675.
3748.	3641.	3521.	3400.	3288.	3180.	3074.	2973.	2875.	2781.	2688.	2588.	2588.
2688.	2601.	2515.	2431.	2353.	2261.	2170.	2077.	2026.	1961.	1961.	1961.	1961.

		STORAGE										
26.	24.	25.	25.	25.	25.	25.	25.	25.	25.	25.	25.	25.
25.	25.	25.	25.	25.	25.	25.	25.	25.	25.	25.	25.	25.
27.	27.	28.	28.	28.	28.	29.	29.	29.	29.	29.	29.	29.
30.	31.	31.	31.	31.	31.	31.	31.	31.	31.	30.	30.	30.
39.	45.	53.	61.	71.	80.	89.	99.	108.	116.	123.	135.	135.
124.	131.	136.	140.	143.	145.	145.	145.	145.	145.	144.	141.	138.
135.	131.	128.	125.	121.	118.	115.	115.	115.	115.	113.	110.	107.
105.	102.	100.	98.	95.	93.	91.	88.	86.	84.	81.	78.	76.
82.	81.	79.	77.	76.	74.	73.	71.	69.	68.	66.	64.	62.
66.	65.	64.	62.	61.	60.	59.	58.	56.	55.	54.	53.	52.
54.	53.	52.	51.	51.	50.	49.	48.	47.	46.	45.	44.	43.
46.	45.	44.	43.	43.	42.	41.	41.	40.	40.	40.	40.	40.

		STAGE										
490.5	490.2	490.3	420.3	490.3	490.3	490.3	490.3	490.3	490.3	490.3	490.3	490.3
490.3	490.3	490.3	490.3	490.3	490.3	490.3	490.3	490.3	490.3	490.3	490.3	490.3
490.6	490.7	490.9	490.9	491.0	491.0	491.0	491.1	491.1	491.2	491.2	491.2	491.2
491.3	491.3	491.3	491.3	491.3	491.4	491.4	491.4	491.4	491.5	491.5	491.5	491.5
492.5	493.1	493.8	494.5	495.2	495.2	495.2	496.5	496.5	497.0	497.5	498.0	498.0
498.4	498.7	499.0	499.2	499.3	499.3	499.3	499.4	499.4	499.4	499.4	499.4	499.4
498.9	498.6	498.4	498.3	498.1	498.1	498.1	498.0	497.8	497.7	497.7	497.5	497.5
497.4	497.4	497.1	497.0	496.8	496.8	496.7	496.5	496.4	496.3	496.3	496.2	496.2
496.0	495.9	495.8	495.7	495.6	495.6	495.5	495.5	495.2	495.2	495.1	495.0	495.0
494.9	494.8	494.7	494.6	494.5	494.5	494.5	494.4	494.3	494.2	494.0	494.0	494.0
493.7	493.8	493.8	493.7	493.6	493.6	493.5	493.4	493.4	493.3	493.3	493.2	493.2
493.1	493.1	493.0	492.9	492.9	492.9	492.8	492.7	492.7	492.7	492.6	492.5	492.5

PEAK OUTFLOW IS 16335. AT TIME 57.00 HOURS

		PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CFS	1635.	16018.	13539.	9144.	618244.		
CMS	463.	454.	383.	231.	17507.		
INCHES		1.26	4.26	7.69	8.11		
MM		32.02	108.25	195.35	205.98		
AC-FT		7943.	26854.	48457.	51095.		
THOUS CU M		9797.	33124.	52774.	63024.		

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS  
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)  
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS				
				RATIO 1 .20	RATIO 2 .40	RATIO 3 .60	RATIO 4 .80	RATIO 5 1.00
HYDROGRAPH AT	A1	118.20	1	3268.	6536.	9803.	13071.	16339.
		( 306.14)		( 92.53)( 185.07)( 277.80)( 370.14)( 462.67)				
ROUTED TO	A2	118.20	1	3268.	6535.	9801.	13069.	16335.
		( 306.14)		( 92.53)( 185.06)( 277.54)( 370.07)( 462.56)				

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....	ELEVATION STORAGE OUTFLOW	INITIAL VALUE 490.00	SPILLWAY CREST 490.00	TOP OF DAM 494.00	TIME OF FAILURE HOURS	TIME OF MAX OUTFLOW HOURS
		0.	23.	23.	55.	3854.
RATIO OF % FMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS
.20	493.58	0.00	50.	3268.	0.00	57.00
.40	495.61	1.61	76.	6535.	25.00	57.00
.60	497.11	3.11	100.	9801.	40.00	0.00
.80	498.32	4.32	123.	13069.	49.00	0.00
1.00	499.42	5.42	145.	16335.	57.00	0.00

FLOOD HYDROGRAPH PACKAGE (HEC-1)  
 DAM SAFETY VERSION JULY 1971  
 LAST MODIFICATION 26 FEB 72  
 N base

APPENDIX 4

REFERENCES

OLD MORRIS CANAL DAM

APPENDIX 4

REFERENCES

OLD MORRIS CANAL DAM

1. U.S. Army Corps of Engineers, Hydrologic Engineering Center, "Flood Hydrograph Package (HEC-1) for Dam Safety Inspections - Users Manual," Davis, California, September 1978.
2. Brater, Ernest F. and King, Horace, Handbook of Hydraulics, Sixth Edition, McGraw-Hill, N.Y., 1976.
3. U.S. Bureau of Public Roads, "Design Charts for Open Channel Flow," October 1960.
4. Department of the Army, Philadelphia District, Corps of Engineers, Pennsylvania 19106. Powerville Dam - Phase I Inspection Report National Dam Safety Program, June 1979.
5. Report regarding Dam Application from John N. Brooks, dated October 31, 1939.
6. Report regarding Dam Inspection from George R. Shanklin dated August 29, 1941.
7. Letter from Robert L. Hardman, Chief of Bureau of Water Control to City Clerk of Jersey City regarding ownership, dated December 12, 1968.